REMARKS

The independent claims, claims 1, 9 and 18, have been amended to change the recitation "a code to output authentication data based on a combination of a pulse voltage and a pulse interval of the random pulses generated by the random pulse generator" to --a code to output authentication data based on a combination of a random pulse voltage and a random pulse interval of the random pulses generated by the random pulse generator-- and to add the feature: --the pulse interval of the random pulses is measured using clock pulses--.

The feature that the pulse interval of the random pulses is measured using clock pulses is supported in the specification of the present application in paragraph [0036] (of US 2008/0235774 A1, the publication of the present application).

Referring to the Final Office Action, the Office has maintained the rejections made previously of claims 1-4, 8-11 and 15-19 under 35 U.S.C. § 103(a) as being unpatentable over Shi (EP 0957220), in view of Shilton (WO 99/41834), and of claims 6 and 13 under 35 U.S.C. § 103(a) as being unpatentable over Shi in view of Shilton, and further in view of Barker (US 5,076,971).

Reconsideration of these rejections is respectfully requested.

In the "Response to Arguments" section beginning on page 13 of

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the Office Action, the Office states:

> "In Paragraph [0017] [of Shi], although the output of A is converted by a D/A converter, the output of A is still used in order to achieve the output of B, and therefore a pulse voltage is used. Since the output of B is used to obtain a spectrum-spreaded signal, a sequence of pulses with random widths is generated, i.e. pulse intervals. Since the sequence of pulses originated from oscillator A, the combination of the pulse voltage and the pulse interval are used to generate random pulses."

However, in Shi, the M-sequence generator B is a pseudo-random code generator - not a random pulse generator. Further, the output of the D/A convertor is an analog signal of which a voltage is variable and the output of the VCO is a sine wave of which the amplitude is constant and of which a frequency is variable. That is, both outputs are not indicative of pulses. Accordingly, the Office's statement quoted above is not correct.

In addition, regarding the technical term "pulses", a detailed explanation is provided later in these "Remarks" in conjunction with Fig. 6. attached to this response.

First, however, the principle of generating a random number

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according to Paragraph [0017] of Shi reference, is explained below with in reference to the drawings, Figs. 1 to 8, attached to this response.

It is assumed for this explanation that the m-sequence random number is "4861746 ...". Figs. 1 to 5 (attached) show a case where an output of a D/A convertor is an analog signal of which a voltage has a waveform as shown in Fig. 1. The voltage of the analog signal corresponding to the random number "4861746 ..." is varied with a pseudo-random rule and a frequency of the analog signal is lower than one fifth of a central frequency of a VCO (see paragraph [0017] of Shi). An output frequency of the VCO is continuously varied with the input voltage of the VCO according to an input/output characteristic of the VCO as indicated in Fig. 2. In Figs. 1-3, a variation range of the input voltage is set as a maximum of a usage range of the VCO. While the frequency of the output of the VCO is varied continuously, the amplitude of the output is constant and it is not varied randomly. That is, as shown in Fig. 4, a waveform of the output of the VCO has a sine curve determined by the input voltage, so that it is not indicative of pulses. Further, since the waveform is continuous, the output of the VCO is periodical and it is not individually or discretely generated.

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Paragraph [0017] of Shi states that the VCO is controlled so as to obtain a spectrum-spreaded signal. But, the output of the VCO merely is varied within a range from a maximum frequency to a minimum frequency and it is not a non-periodic or random spread signal. An output of the VCO based on an input voltage corresponding to one M-sequence number continuously is varied till a voltage corresponding to the next number is input, as shown in Fig. 4. The output has the levels "0" and "1" appearing alternately and regularly along a time axis. Also, a time period (①, ②, ... , ⑧) up to the input of the next voltage is constant (for example, it is equal to a period of time corresponding to a frequency of one fifth of the central frequency of the VCO). Here, it is noted that the time periods are not illustrated in Fig. 4 (or in Fig. 7) (①, ②, ... , ⑧) as having the same interval, in order to advance an understanding of applicant's arguments.

In order to avoid the periodicity of the output of the VCO having the levels "0" and "1" appearing alternately and regularly along a time axis, the Shi reference samples the output of the VCO by a clock signal having a frequency lower than one tenth of the lowest frequency of the VCO to generate random codes, digital numeric values A to D as shown in Fig. 5. However, the digital numeric values A to D are merely different in the number of digits,

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and each of them has "0" and "1" still appearing alternately and thus still keeps the periodicity. This is also true for a random code generated by the logic operation EXCLUSIVE OR of the sampled output of the VCO using the triggers.

Shi does not disclose a case where an output of a D/A convertor is a signal of which a voltage has a rectangular waveform as shown in Fig. 6. But, even in such case, an output of the VCO (see Fig. 7) and sampled outputs of the VCO (see Fig. 8) are obtained in the same way as the output of the VCO (see Figs. 3 and 4) and the sampled outputs of the VCO (see Fig. 5), respectively.

In this connection, it is noted that "the signal of which a voltage has a rectangular waveform" as shown in Fig. 6 is not indicative of pulses. An example of the pulses is shown at the lower left on Fig. 6. Paragraph [0017] of Shi discloses that levels (of the analog output converted by the D/A convertor) are varied, and said levels are used to control a voltage-controlled oscillator (VCO) so as to obtain a spectrum-spreaded signal. Clearly, the levels of the analog output are continuously varied, so that they are not indicative of pulses generated individually or discretely, as shown in the lower left of Fig. 6. In this light, "the signal of which a voltage has a rectangular waveform" is not indicative of pulses, either.

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As explained above, "a combination of a pulse voltage and a pulse interval of the random pulses" in each of independent claims 1, 9 and 18 has been amended to -- a combination of a random pulse voltage and a random pulse interval of the random pulses--. This amendment further clarifies that "pulses" as set forth in the claims of the present application do not include a rectangular waveform such as shown in Fig. 6.

As can be understood from the foregoing, Shi discloses a pseudo-random code (m-sequence) generator. However, Shi does not disclose or suggest a random pulse generator. Further, since the output of the VCO is an analog signal, no digital pulses are generated.

In Shi, if an output of the VCO were provided as pulses, it would be required that an input of the VCO is synchronized with an output frequency of the VCO and that the input is a pulse signal which enables cutting-off thereof at one half of one wavelength. However, Shi has nothing to indicate such facts. Further, according to paragraph [0017] of Shi, a frequency of the oscillator A should be lower than one fifth of the central frequency of the VCO. Thus, an analog output of the D/A converter, i.e. an input voltage of the VCO, changes at a frequency lower than one fifth of the central frequency of the VCO, and as a result, a frequency of

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the output of the VCO changes according to the input voltage. Accordingly, it is not possible that an output of the VCO has a pulse waveform.

In the last paragraph on page 2 of the Office Action, the Office states: "*Shi*, Paragraph [0008], The random code generator IC3 is a *random pulse generator*, and is arranged in the body" (emphasis in the original), and "*Shi*, Paragraph [0009], The random pulse generation is disclosed in Fig. 3 and Paragraph [0017]". However, the phrase "random pulse" is not disclosed in any of the cited paragraphs [008], [009] and [0017].

Further, in the second paragraph on page 14 of the Office Action, the Office alleges that the term "pulse width", taken in light of the specification, may be interpreted as the pulses with random widths as in Shi (citing Shi, paragraph [0015]). However, this allegation is not supported because it is not clear at what part and in what document the term "pulse width" is employed or suggested.

According to Shi, paragraph [0015], "a series of random numbers can be obtained sampling said sequence of the pulses with an independent clock pulse of low frequency". That is, as shown in the following drawing, the number of pulses is counted between the clock pulses of low frequency.

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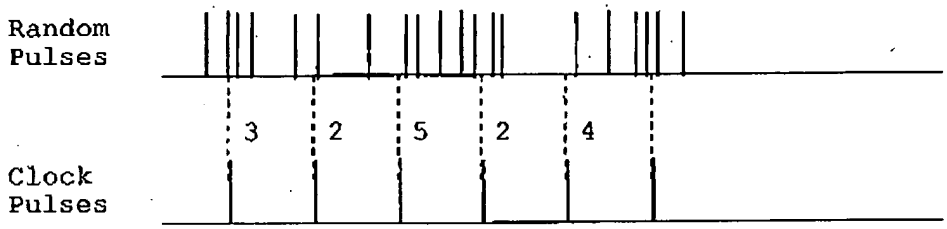

In contrast, in the present invention, as shown in Fig. 9 of the present application and its description in the specification, the interval of the random pulses is measured by counting the number of clock pulses and the counted number of clock pulses can be used as a random value. As explained above, this feature has been added in each of independent claims 1, 9 and 18.

Since the random pulse generator of the present invention detects alpha particles, a beta ray or a gamma ray released by the collapse of an atomic nucleus, the present invention can obtain true random pulses. However, in Shi, the M-sequence generator (a pseudo-random generator) is used (see paragraph [0017], line 48), so that the output of the D/A convertor (i.e. the input of the VCO) also has pseudo-random characteristics (see paragraph [0017], lines 49-50). Since the VCO has linear characteristics between an input

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voltage and an output frequency, the output of the VCO also has pseudo-random characteristics. Subsequently, each of an output of trigger D1 and an XOR of the outputs of triggers D1 and D2 also has pseudo-random characteristics. As a result, in Shi, true random pulses cannot be obtained.

On page 3, lines 6-8, of the Final Office Action, the Office alleges: "The random numbers generated are determined by a sequence of pulses with random widths, thus a pulse interval (see Shi, paragraph [0015])". However, this description is not found or supported in paragraph [0015]. Paragraph [0015] merely states: "[a] circuit is designed to amplify and gating the noise produced by the element so as to obtain a sequence of pulses with random widths" (lines 23-25). Further, the paragraph states: "[s]ince the pulse widths of said sequence of the pulses depend on the noise of the avalanche effect and various parameters of the circuit (e.g. amplifying gain, threshold value, working point, etc.), some special technical measures, ... " (lines 28-31). Accordingly, the Office's allegation is not proper.

Also, a wavelength of the output of the VCO changes according to the input voltage, but a time period up to the input of the next voltage is constant. Since the output of the VCO does not indicate a pulse waveform, Shi discloses nothing to indicate the feature of

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the present invention, i.e., "the pulse interval of the random pulses is measured using clock pulses".

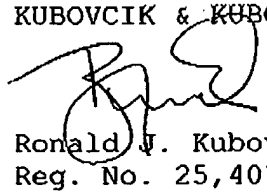
Therefore, the present invention as defined in the claims is quite different from Shi in how to generate a random pulse.

For the above reasons, the combination of Shi and Shilton, with or without Barker, fails to support a case of prima facie obviousness of the claims under 35 U.S.C. § 103(a) and removal of the final rejections and an allowance of the claims are in order.

The foregoing is believed to be a complete and proper response to the Office Action dated January 18, 2011.

In the event that this paper is not considered to be timely filed, applicant hereby petitions for an appropriate extension of time. The fee for any such extension and any additional required fees may be charged to Deposit Account No. 111833.

Respectfully submitted,
KUBOVCIK & KUBOVCIK



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Attachment: Applicant's Figs. 1-8 (three pages)

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